Command Agents Research

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Structure

- Overview of CARE project
- Command Agent architecture
- Generic knowledge bases
- Terms of reference

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What is a Command Agent?

- Software which represents the command and control decision-making of a command post
- Communicates with other command agents and entities via orders and reports
- Represented as an entity within a battlefield simulation
- Currently at battlegroup, brigade and div level

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Command Agents Research (CARE)

- Multi-application, collaborative programme to share development costs of C2 Modelling
- Supports four Applied Research Packages, for training and operational analysis
- Produce generic Command Agent software
- Open Modular Approach
- Standard Interfaces
- Based on GeKnoFlexE Command Agent work

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Command Agent Requirements

- Command and Control Representation
  - multiple levels and sub functions
  - scalable framework for use with different simulations
- User Interfaces
  - to develop, validate, control and monitor CAs
- Human Command Agent Interaction
  - overruling/modification, transfer of command
- Interaction with Simulations
  - magic moves, re-execution, rewind and fast forwarding
  - use of simulation models
- Generic Knowledge Bases
- Standards

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Architectural Overview

KEY

Reports and orders passed between command agents and units

Simulation units under control of command agents

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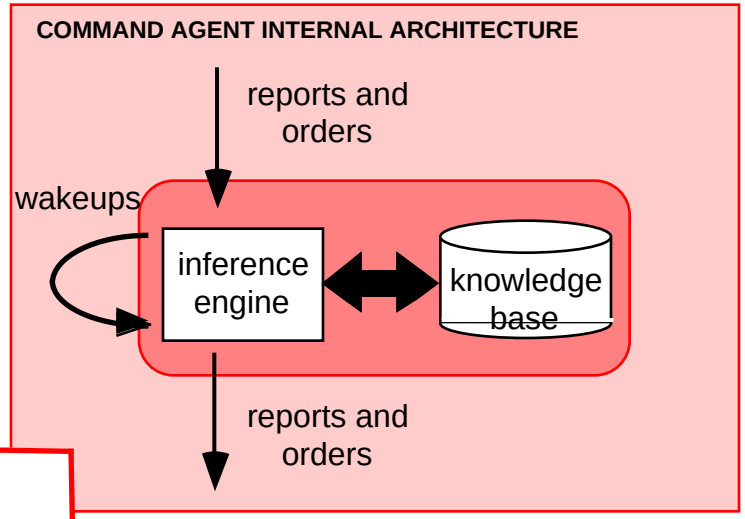
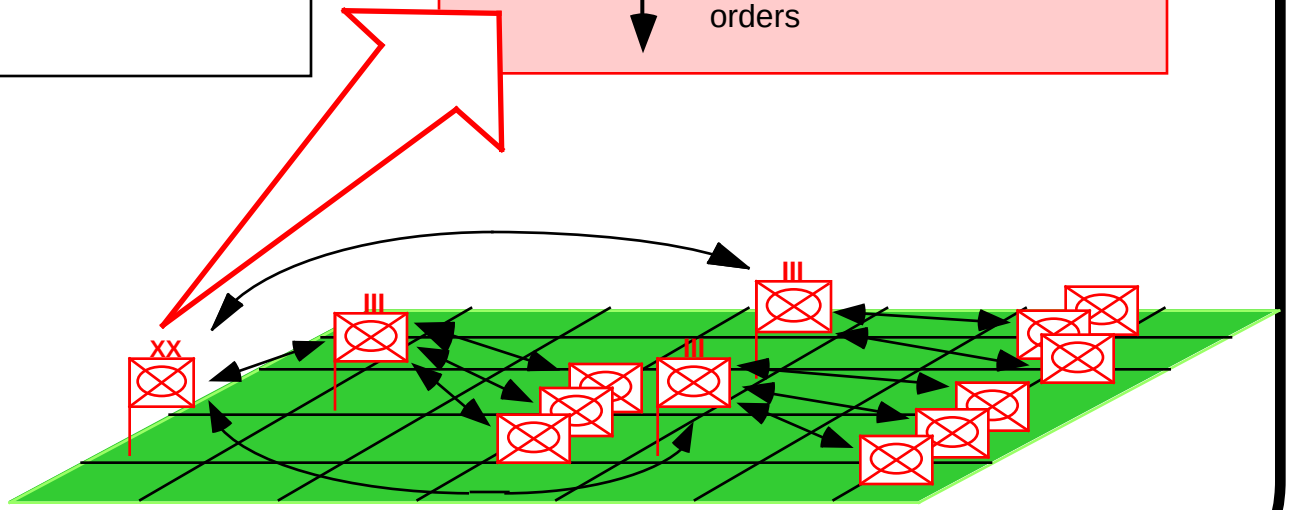
Command agent representing a Command Post





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CA Knowledge Bases

- Domain knowledge
  - battlefield perception stored in an object structure
  - initialised with details of own forces
  - built up as the scenario progresses
- Problem-solving knowledge
  - tactics elicited from military experts
  - hierarchy of if-then rules grouped into tasks and used to make up knowledge sources
  - deterministic
  - invoked by reports, orders and wakeup messages

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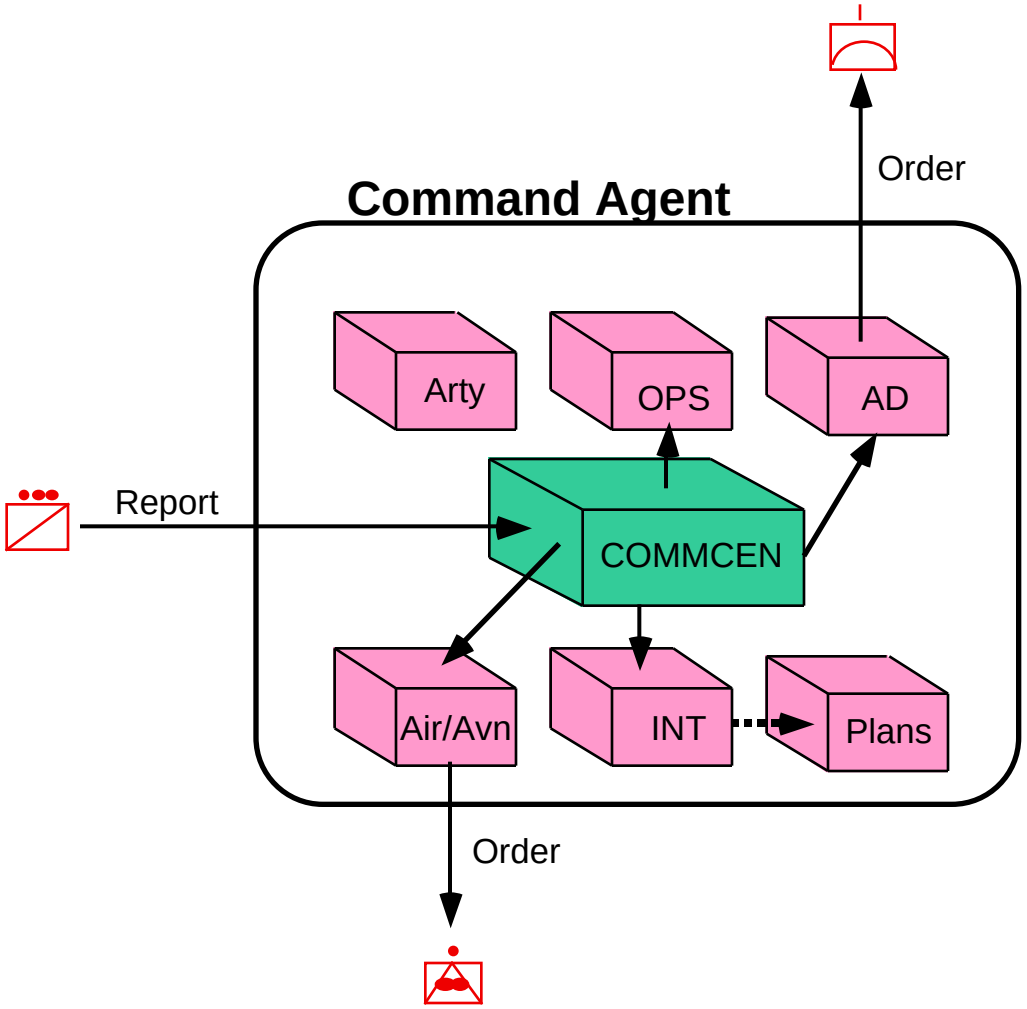
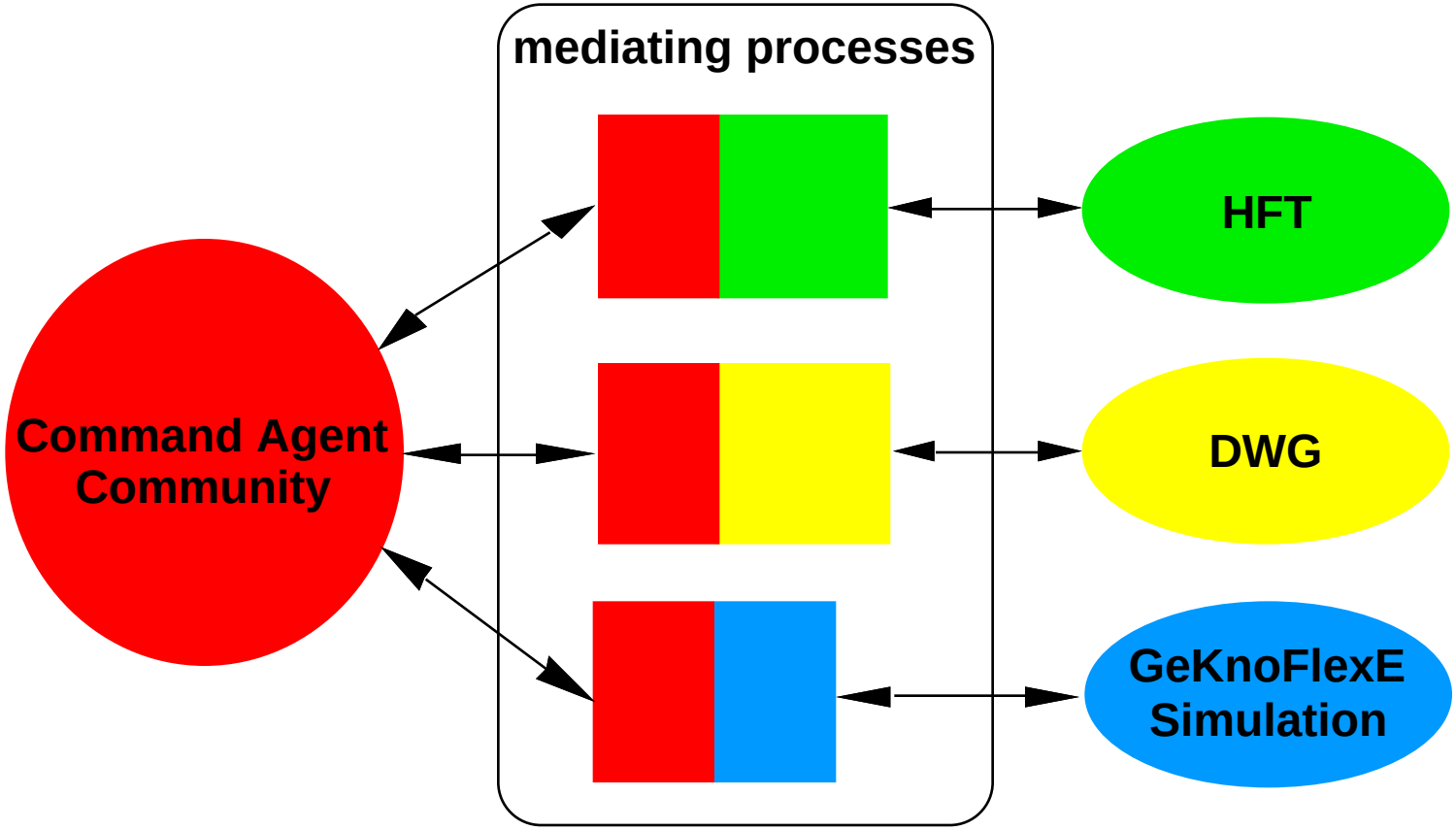

Command Agent
Order
Arty
OPS
AD
Report
COMMCEN
Air/Avn
INT
Plans
Order

Mediating Process Principle



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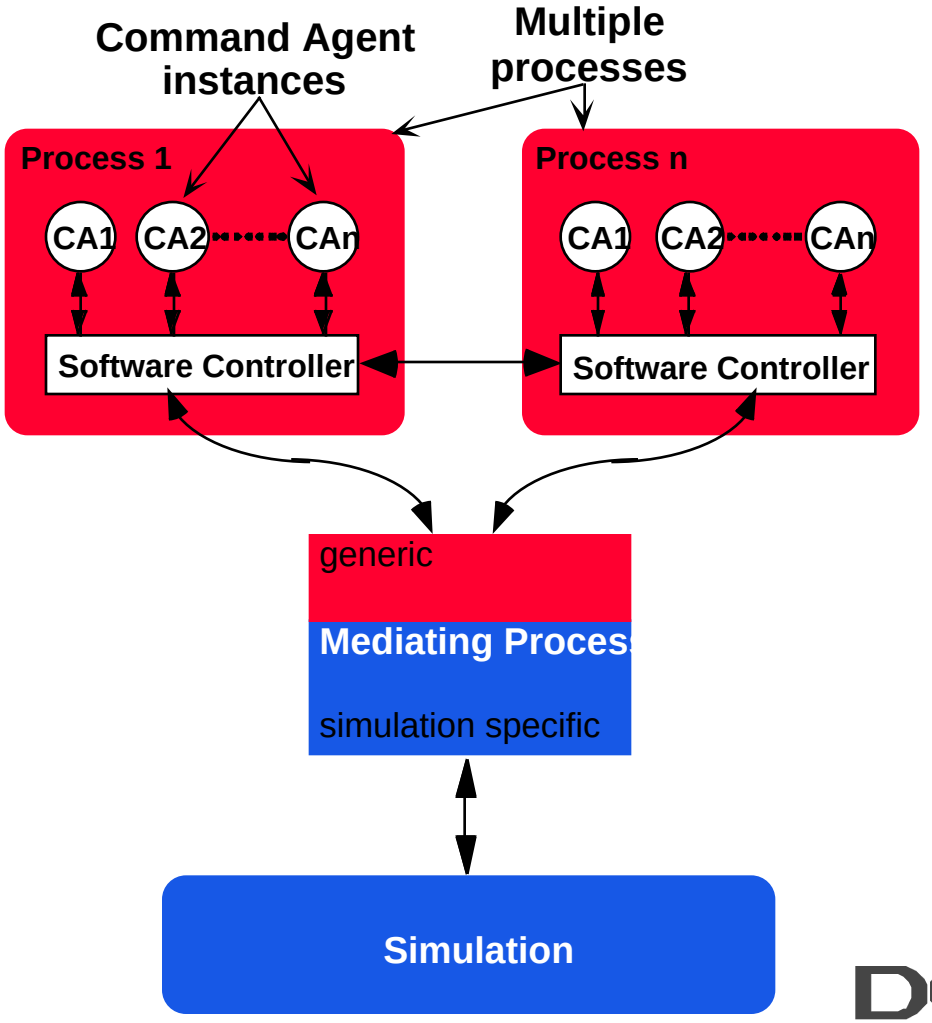
CA Architecture Overview



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Knowledge Bases

- **Existing knowledge bases are concept of operation dependent**

- **Command Agent Research Initiative to develop more scenario independent knowledge bases**

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Generic Knowledge

Knowledge which can be used:

- by one Command Agent within **many** scenarios
  - core knowledge which a Command Agent needs in any scenario
- by many **types** of Command Agent within one scenario
  - different echelons, sub-functions and sides can often use the same rules and domain knowledge structures

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Developing Generic Knowledge

- Knowledge base development is focused on a specific scenario to constrain the problem space but more generally applicable rules are identified so that they can be reused in other scenarios
- Each sub-function of the different echelons and sides is developed by the same team so that commonality can be identified more easily
- Where possible data is passed as parameters to rules so that they are more generally applicable

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I. Simulated Battle Context of Command Decision Making

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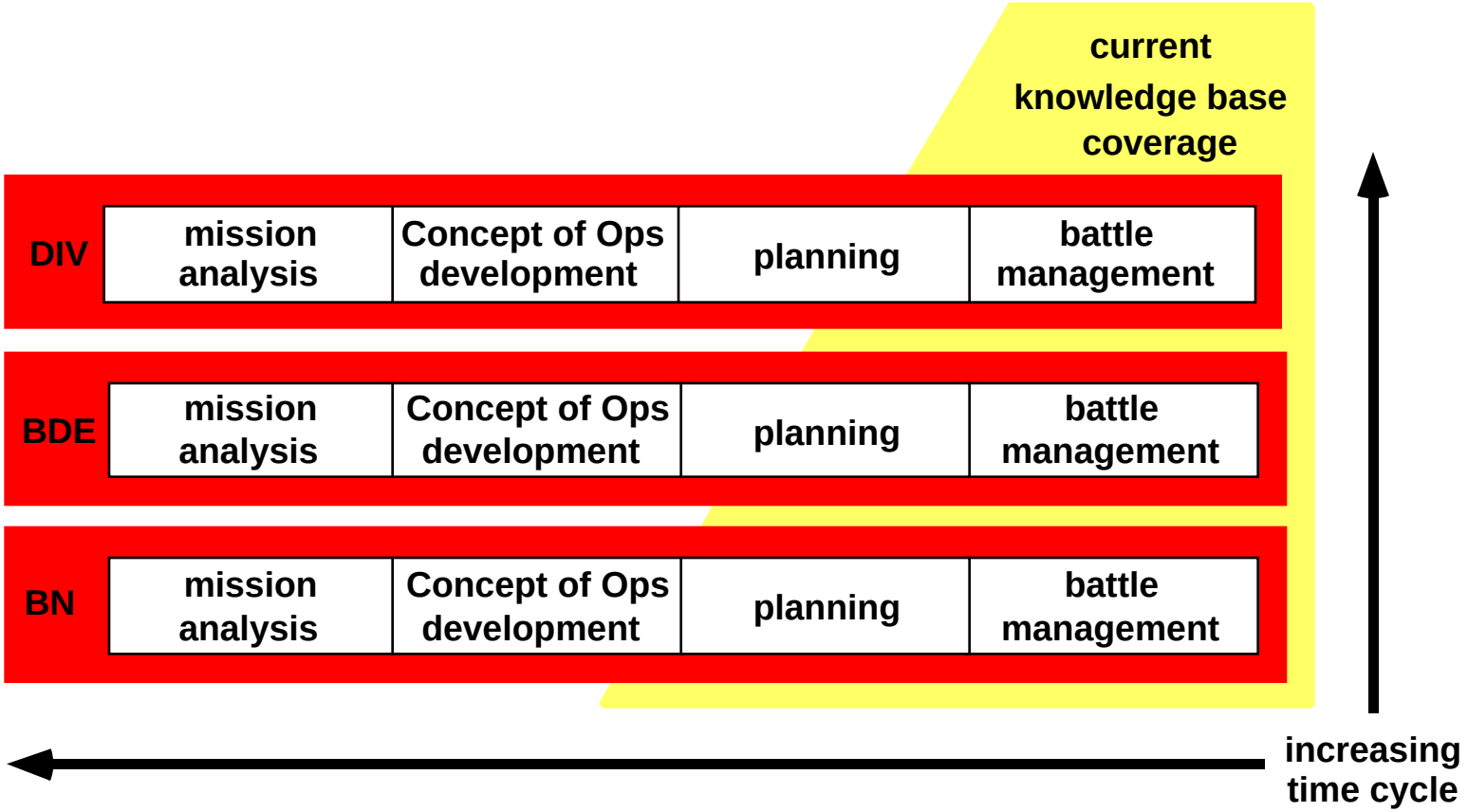
Level of Decision Representation



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Representation of Current Battle State

- Each Command Agent has its own private perception of the battlefield
- Stored in an object structure
- Initialised with details of own forces
- Built up as the scenario progresses from intelligence and situation reports - data fusion is eased by using unique IDs for each unit

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Domain Knowledge

- Perceptions of own and enemy units
- Situation assessment
  - details of superior unit
  - capabilities and formation of subordinates
  - current activity
  - routes used
- Record of threat within surrounding terrain areas
  - enemy formations recognised
- Battle plans
  - time, primary location, units involved
- Battle assessments
  - perceived enemy strength and location, damage taken

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Representation of Own & Enemy Battle Plans

- Own battle plan
  - the Command Agents work to a high level concept of operations which is embodied within their rule bases, e.g. attack or defend
  - battle plan objects are created dynamically by each Command Agent's rule base as required
- Enemy objectives
  - details of enemy activities are solely received through sensor and situation reports
  - reported information is disseminated up and down the command hierarchy
  - reported information is pieced together to identify enemy formations and the terrain areas they are moving through

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II. Decision Process

- Assessment of current/future status
  - rules use current perception to determine action to be taken
  - limited future battle status prediction - looks ahead to see where and when a Bde attack might be needed
- Decision actions
  - explicit orders are sent to lower echelons to implement decisions
- Dynamic/reactive decision making
  - Command Agents create battle plans dynamically as required within the overall (limited) concept of operations
- Doctrinal context
  - Command Agents maintain a record their current status in their domain knowledge base

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III. Simulated Support to the Decision Process

- Sensor support
  - the Command Agent's perception of the enemy is entirely built up from sensor reports containing location, size and activity information
  - sensor reports do use a unique enemy ID
- Information operation activities
  - a Command Information System is simulated which provides updates on the location of friendly forces
  - friendly forces also send situation reports to their superiors

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IV. Architectural Aspects

- Command levels at which live battle staffs can be used in the simulation
  - used for studies without any human interaction
  - human interaction facilities currently at prototype stage
    - used for automating OPFOR at Bn, Bde and Div levels
    - used for reducing controller workload by automating Bns - controller would interface to trainees
- Required levels of fidelity
  - the level of fidelity of the lowest echelon of Command Agent must match the level of fidelity of the simulation
  - the higher echelon Command Agents will use information aggregated up the chain of command
  - cells within a command post are represented and explicit messages are sent over a skeleton comms network

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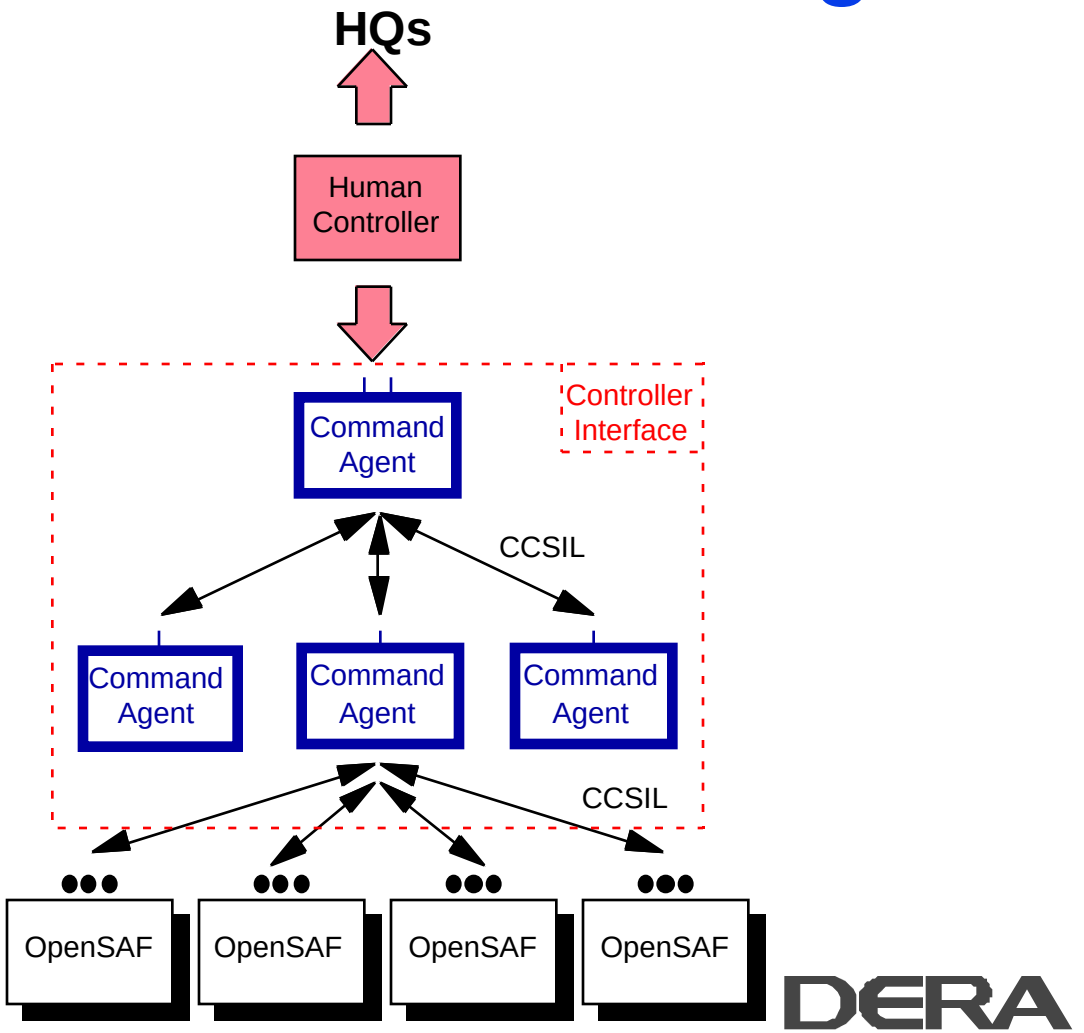
UK STOW Command Agents



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V. Other Issues

- Adequacy of behavioural representation - reactive to intelligent
- Maximising of setting/scenario independence
- Flexibility - what should be represented? - doctrine versus reality
- Controller support versus complete automation
- Knowledge representation techniques to fit each type of decision making to be modelled - hybrid system
- Decision traceability and VV&A
- Facilities to allow: explanation, overruling / modification of decisions, ‘man in the loop’, transfer of command, fast forward, rewind, after action review

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